RAPID BRIDGE REPAIR WORKSHOP

PREFABRICATED BRIDGE ELEMENTS

MAY 22, 2009

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Senior Structural Engineer

FHWA Resource Center Structures Technical Service Team

OUTLINE

- Introduction
- Buzz Words
- Major Initiatives
- ACTT Approach
- Highways For Life (HfL)
- Prefab Bridge Elements/System Scan
- Prefab Scan Technologies

OUTLINE

- Innovative Use Of Prefabricated Systems
- Success Stories Of US Prefabricated Bridges
- Survey Of State Bridge Engineers
- Decision Making Framework
- Connection Details For Prefabricated Bridge Elements & Systems
- Summary

TRAFFIC CONGESTION

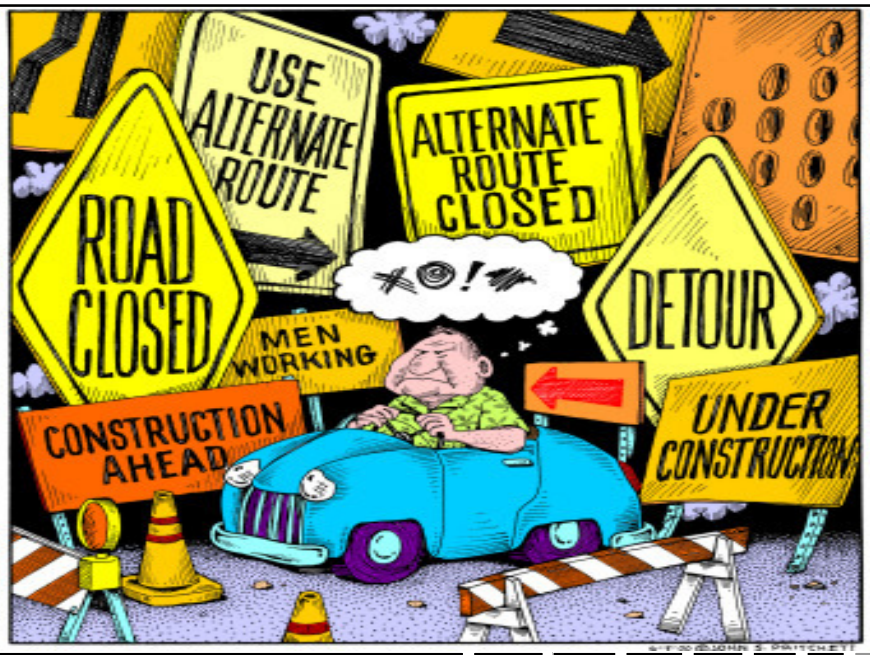
- The nation's 4 Million mile highway system is considered most extensive and heavily traveled highway network
- Unprecedented increase in traffic volumes coupled with our aging infrastructure have caused highway construction activities to intensify

LANE CLOSURES

- It is not just the congestion, it is the safety
- Annual loss of 40,000 lives due to accidents
- $63 Billion annual loss due congestion

Present and Future Challenges

- Aging Infrastructure….1/3 in Poor Condition
- 70% Increase in Freight Tonnage Between 1998 and 2020
- 90% of urban interstate expected to exceed/approach capacity by 2020



BUZZ WORDS

Get In

Get It Done (& Done Right)

Get Out

Stay Out

MAJOR INITIATIVES

- Accelerated Construction Technology Transfer (ACTT)
- Highways For Life (H4L)
- AASHTO/FHWA Prefab Bridge Scan
- Innovative Use Of Prefabricated Systems
- PBES Decision Making Framework
- Connection Details For Prefabricated Bridge Elements & Systems

ACTT APPROACH

- Encourage the development of strategies that generate positive change.
- Create a framework for informed consideration of innovations.
- Facilitate removal of barriers to innovation
- Improve motorist and worker safety.
- Advocate continuous quality improvements.

ACTT's GOAL

- ACTT Addresses The Construction Time And Traffic Congestion Concerns Of Today's Large, Complex Multi-phase Projects

Systems or Concepts to Accelerate Construction

- Ground up
- Material Choices
- Equipment
- Prefabrication
- Access Logistics
- Pre-assembly
- Pre-purchase & Fabricate

Systems or Concepts to Accelerate Construction

- Off-site Assemble
- Off site roll-in/lift-in
- Incremental Launching
- Longitudinal vs Transverse Components

What is Accelerated Bridge Construction?

- Fast track process
- Prefabricate bridge elements and systems
- Elements constructed off-site
- Lift into place
- Reduce on site construction time and traffic impact

Why Now?

- One Third of US Bridges need Rehabilitation or Replacement
- Lane closure can cause significant traffic and economical impact
- Minimizing traffic impact is a crucial issue

Advantages

- Reduces on-site construction time
- Minimizes traffic disruptions
- Improves work zone safety
- Minimizes environmental impact
- Improves constructibility
- Increases product quality and
- Lowers life-cycle-costs

GET IN, GET OUT, STAY OUT

Reduces On-Site Construction Time

- Less time spent on-site
- Traditional tasks can be done off-site
- Minimal impact from weather conditions

MINIMIZES TRAFFIC IMPACTS

- Minimizes traffic delay and community disruption

I-59 and I-65 Interchange, AL

US 59 under Dunlavy, TX

- Reduces detours, lane closures, and narrow lanes

IMPROVES WORK ZONE SAFETY

- Minimizes work near traffic and power lines, at high elevations, or over water.

Meylan Pedestrian Bridge, France

Minimizes environmental impact

- Keep heavy equipments out of sensitive environment

Linn Cove Viaduct, NC

Improves Constructibility

- Minimal impact from environmental constraints
- Relieves from constructibility pressure.

San Mateo-Hayward Bridge, CA

Increases quality

- Prefabricated in a Controlled environment
- Increases quality control

George P. Coleman Bridge, VA

HIGHWAYS FOR LIFE (HfL)

Long Lasting

Innovative

Fast Construction

Efficient and Safe

HIGHWAYS FOR LIFE (HfL)

- Utilize Proven Successes
- Involve New Stakeholders
- Do The “Never Been Done”
- Be Bold And Audacious

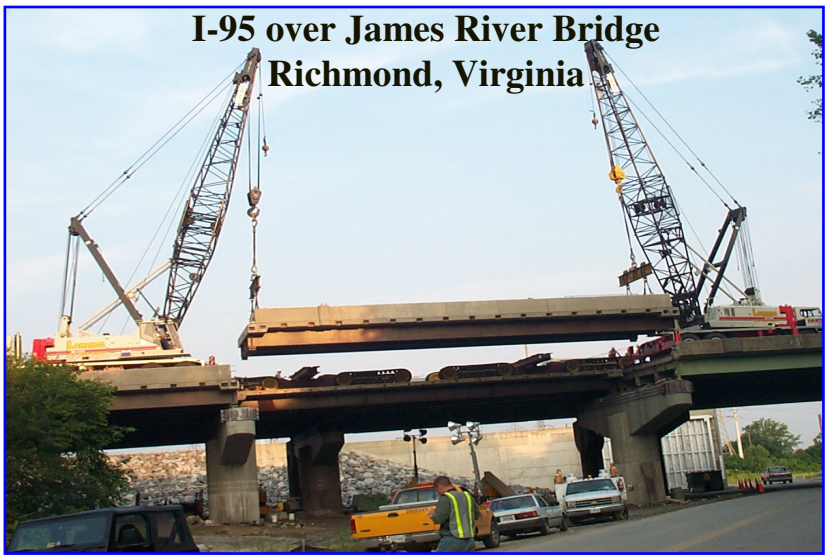
HfL VISION AND GOALS

- Improve Safety
- Reduce Congestion Due To Construction
- Improve Quality

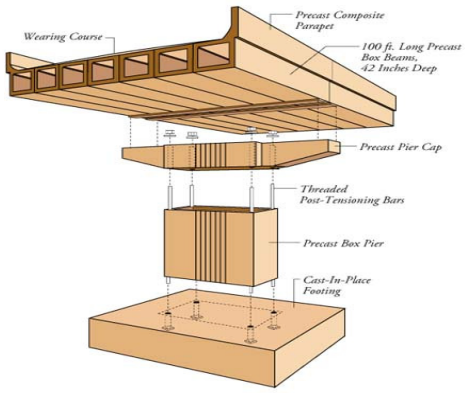
IT'S BEEN DONE

IT'S BEEN DONE

I-95 over James River Bridge
Richmond, Virginia



IT'S BEEN DONE



Baldorioty de Castro Avenue Bridges
San Juan, Puerto Rico

PREFAB BRIDGE ELEMENTS/SYSTEMS SCAN

- MISSION STATEMENT
- TEAM MEMBERS
- SCAN COUNTRIES
- TOPICS OF INTEREST
- TECHNOLOGIES

MISSION STATEMENT

- To investigate and document project experiences with prefabricated bridge elements and systems in Japan and selected European countries with emphasis on accelerated technique to replace existing or construct new routine bridges.

TEAM MEMBERS

FHWA:

- **Benjamin Tang, Co-Chair**
- **Claude Napier, Jr., VA**
- **Barry Brecto, WA**

Academia:

- **Eric Matsumoto, CSUS, CA**

Industry:

- **Henry G. Russell, IL**
- **Shri Bhide, PCA, IL**

State DOTs

- **Mary Lou Ralls, Co-Chair, TX**
- **Harry Capers, NJ**
- **William Nickas, FL**
- **Dan Dorgan, MN**

National Association of County Engineers:

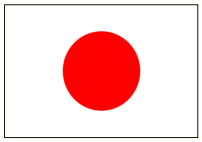
- **Eugene Calvert**

Contractor: John O'Neill, ATI

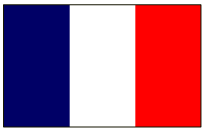
SCAN COUNTRIES

Netherlands

Belgium



Japan



France

Germany

TOPICS OF INTEREST

- Minimized traffic disruption (Congestion)
- Improved work zone safety
- Minimized environmental impacts
- Improved constructability
- Improved product quality
- Lower life-cycle costs

PREFAB SCAN TECHNOLOGIES

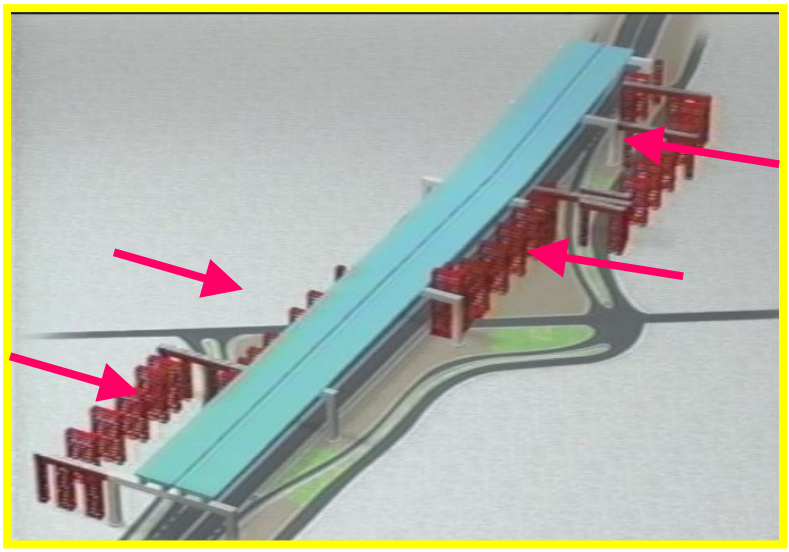
- LONGITUDINAL & TRANSVERSE LAUNCHING
- U-SHAPE SEGMENTS WITH TRANSVERSE RIBS
- HYBRID STEEL DECK FORMS
- FULL DEPTH PRETENSIONED PRECAST DECK PANELS
  - GROUT POCKETS AND TRANSVERSE JOINTS
  - LOOP BAR JOINT AND CLOSURE POUR

PREFAB SCAN TECHNOLOGIES

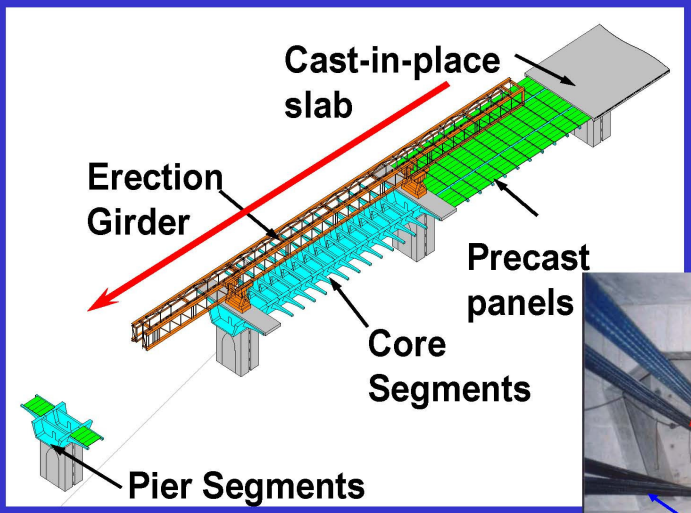
- SPER SYSTEM
- MULTIPLE LEVELS OF CORROSION PROTECTION USING OVERLAYS
- TEE AND BOX BEAMS
- PARTIAL-DEPTH PRECAST DECKS ON STEEL BEAMS
- SELF-FROPELLED MODULAR TRAILERS
  - o MOVING WHOLE STRUCTURES

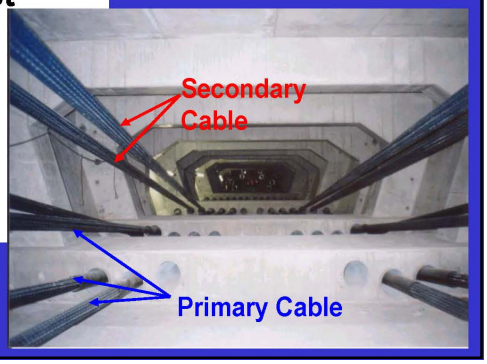
CONTINUOUS LAUNCHING

TRANSVERSE LAUNCHING



U-Shaped Precast Segments

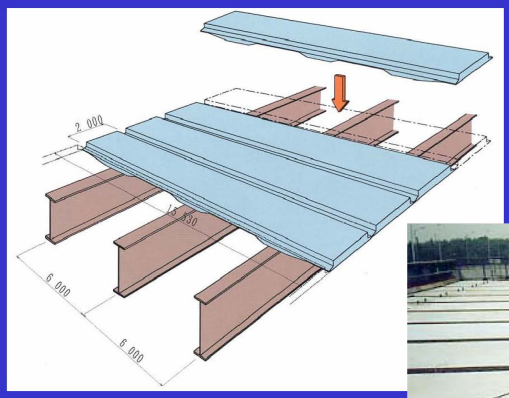




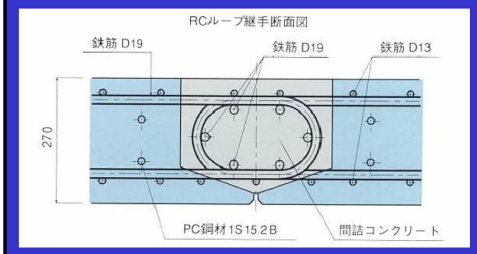
U-Shaped Precast Segments with Transverse Ribs

Hybrid Steel Deck Forms

Full-Depth Pretensioned Precast Deck Panels

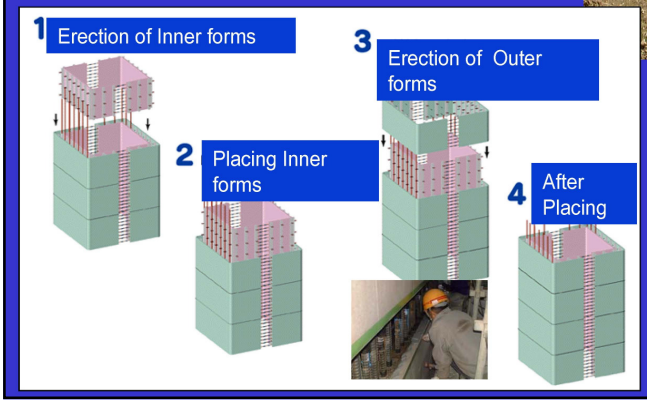


Grout Pockets and Transverse Joints

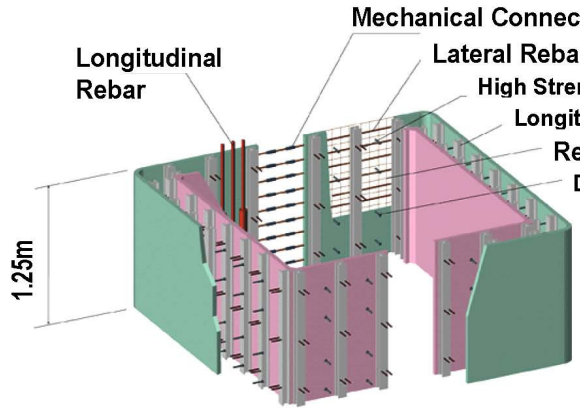


LOOP BAR JOINT AND CLOSURE POUR

SPER System

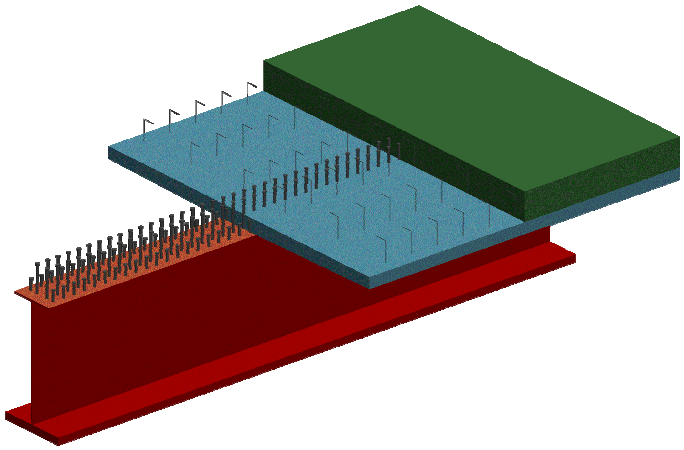


SPER System



Multiple Levels of Corrosion Protection Using Overlays

PARTIAL-DEPTH PRECAST DECKS ON STEEL BEAMS



Self-Propelled Modular Trailers

SELF-PROPELLED MODULAR TRAILERS (SPMT)

One-Man Operator

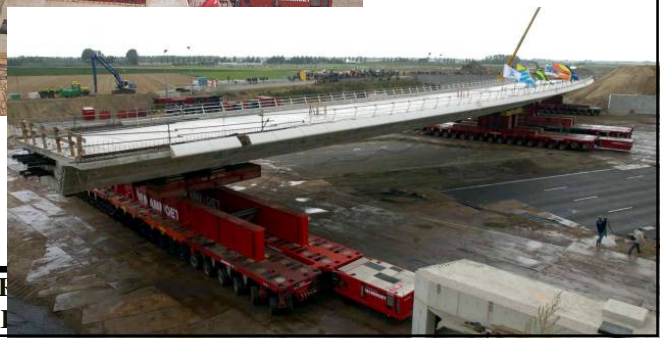
MOVING & ERECTING STRUCTURES

- Mammoet
- Sarens

MOVING A WHOLE SUPERSTRUCTURE

Badhoevedorp, Netherlands

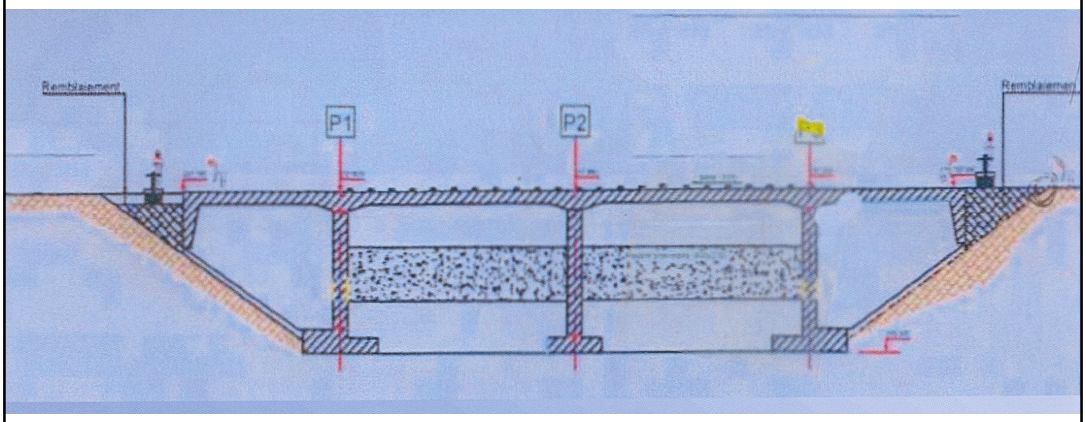
April 2004
Prefabricated
Bridges
International
Scan



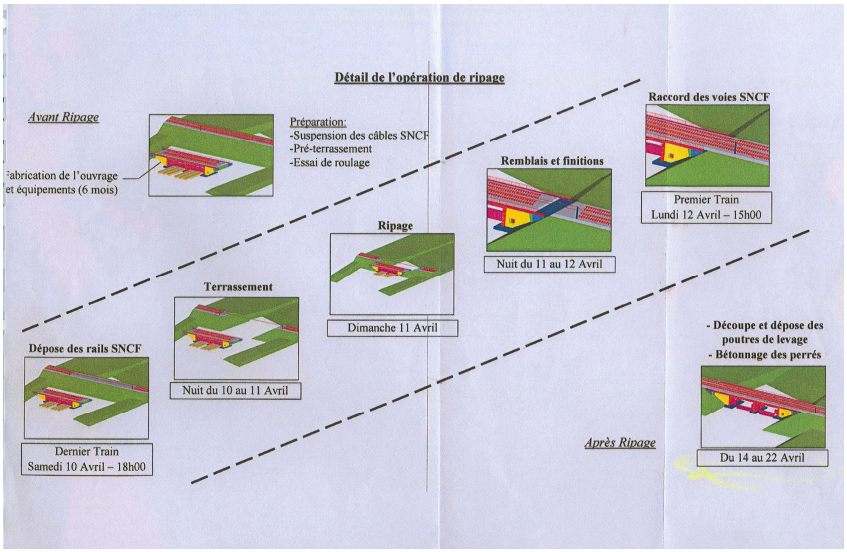
Superstructure Roll-In:
390-ft Length,
3300 M Tons,
2 Hours to Move,
1 Weekend Road Closure

MOVING THE WHOLE BUILDING

BRIDGE SCHEMATIC



MOVEMENT OPERATION



MOVED BRIDGE WITH SPMT

RAPID BRIDGE REPAIR TECHNIQUES WORKSHOP
PREFABRICATED BRIDGE ELEMENTS

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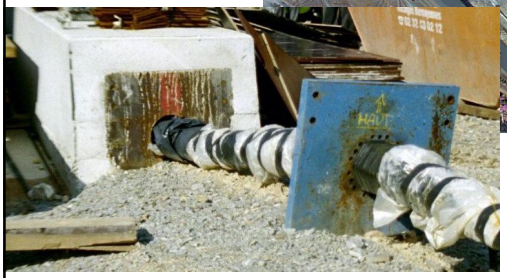
BRIDGE TO BE MOVED



Horizontal Sliding with strand jacks

RAPID BRIDGE REPAIR TECHNIQUES WORKSHOP
PREFABRICATED BRIDGE ELEMENTS

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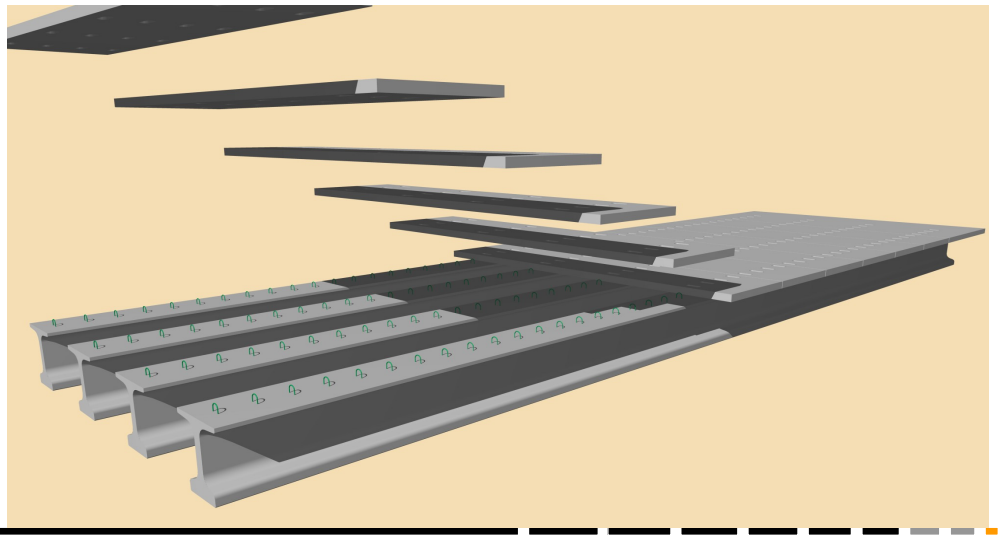
Prefabricated Elements

- Decks
- Total superstructure systems
- Bent caps
- Columns
- Total substructure systems
- Foundation
- Total prefabricated bridges

Prefabrication Focus: Innovative Elements & Systems

- **Superstructures**
  - **Deck Panels**: Full-Depth
  - **Beams:** More Efficient Shapes
  - **Total Superstructure Systems**: Composite Units, Truss Spans
- **Substructures**
  - **Caps**
  - **Total Substructure Systems**: Abutments, Cap/Column(s), Pier(s)
- **Totally Prefabricated Bridges**

Superstructure Prefabrication



RAPID BRIDGE REPAIR TECHNIQUES WORKSHOP
PREFABRICATED BRIDGE ELEMENTS

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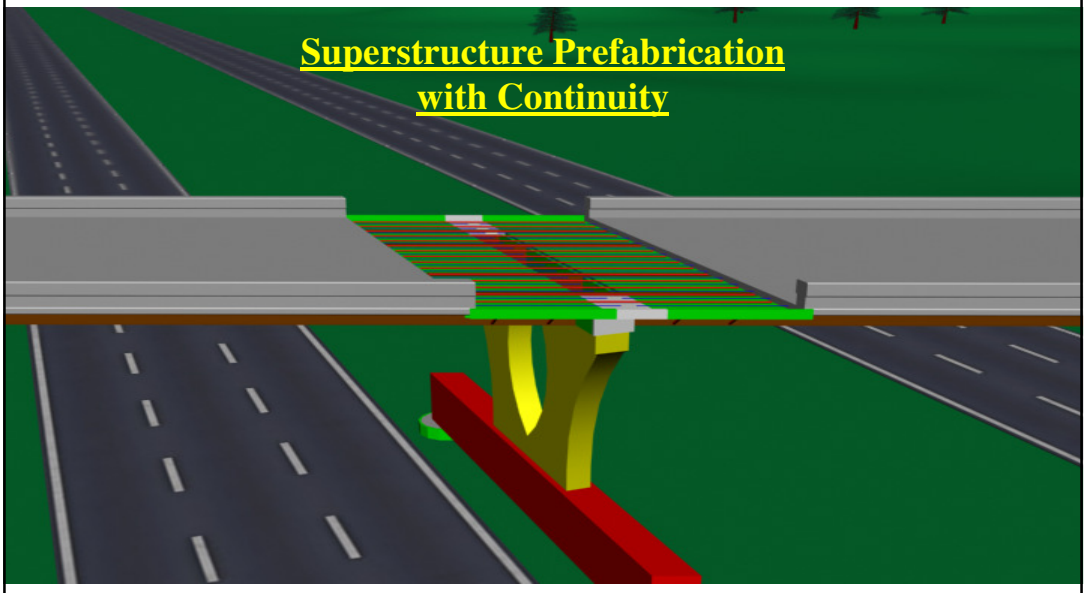
Superstructure Prefabrication with Continuity



RAPID BRIDGE REPAIR TECHNIQUES WORKSHOP
PREFABRICATED BRIDGE ELEMENTS

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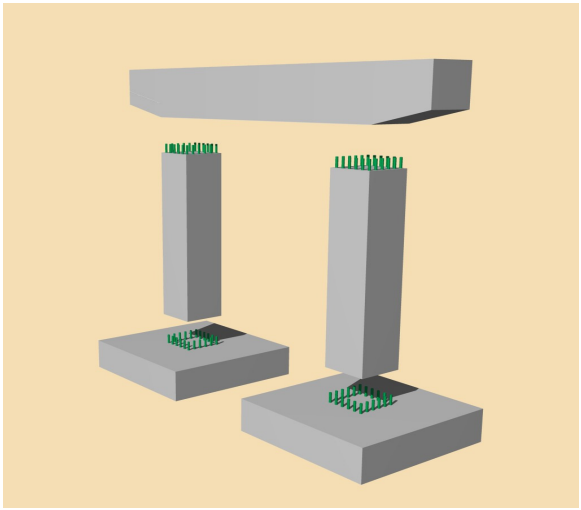
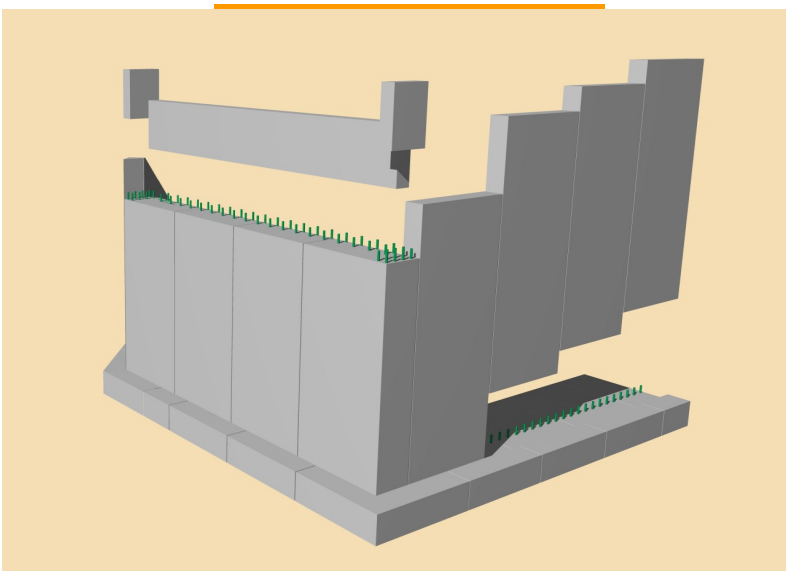
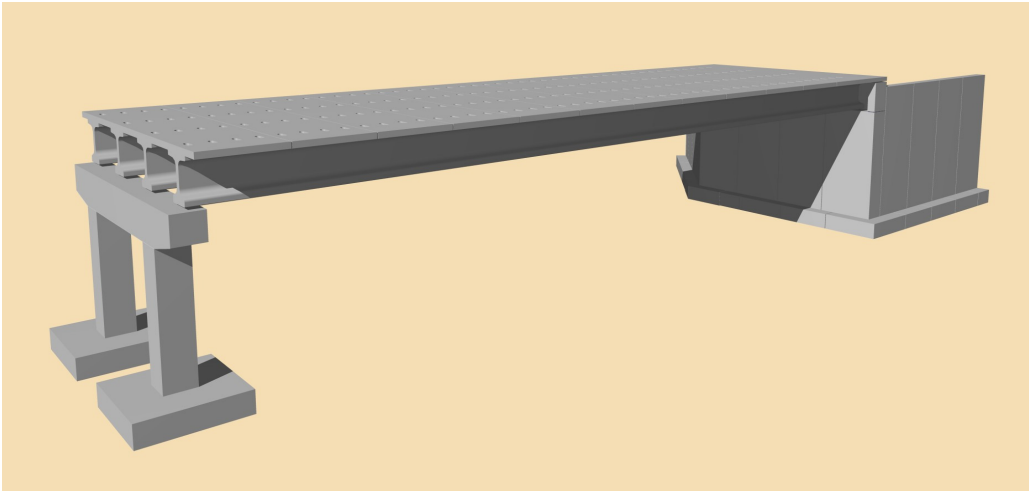
Precast Piers



Precast Abutments



Total Bridge Prefabrication



Prefabricated Bridge Success Stories

A few examples…

SR-433 Lewis and Clark Bridge Columbia River, WA/OR–2004

Replaced 3900 ft of deck using SPMTs during 120 nights plus four weekend closures …

… with no impact to rush-hour traffic

Lewis and Clark Bridge, SR 433 over Columbia River – 2004

103 full-width, full-depth precast lightweight concrete panels, each 36-ft wide x 20-45 ft long

Lewis and Clark Bridge Deck Replacement Construction Costs

- ✓ Number of bidders 6
- ✓ 2nd lowest bid $ 29.2 M
- ✓ Low Bid $ 18.0 M
- ✓ Savings – 38 % = $ 10.8 M
- ☑ Closures: Only 120 nights & 4 weekends
- ✓ Engineer's Estimate $ 28.8 M

I-95 James River Bridge Richmond, VA – 2002

… with no lane closures during rush-hour traffic

100 superstructure spans replaced in 135 nights

Virginia's Superstructure Replacement of
I-95 James River Bridge

James River Bridge Superstructure Replacement Construction Costs

✓ Engineer's Estimate		$ 48.5 M
✓ Number of bidders		5
✓ 2nd lowest bid		$ 44.9 M
✓ Low Bid		$ 43.4 M
✓ Savings	– 11 % =	$ 5.1 M

Closures: Only 135 nights

SH-66 Lake Ray Hubbard Bridge near Dallas, TX – 2003

…proposed by the Contractor

43 identical precast concrete bent caps …

SH-66 Lake Ray Hubbard Bridge near Dallas, TX – 2003

Precast bent caps – the best solution for site conditions

Lake Ray Hubbard Bridge with Precast Bent Caps Construction Costs

✓	Engineer's Estimate		$ 48.2 M
✓	Number of bidders		8
✓	2nd lowest bid		$ 43.1 M
✓	Low Bid		$ 40.9 M
✓	Savings	– 15 % =	$ 7.3 M

Onsite Time Savings: 215 Days

WELLS STREET BRIDGE, CHICAGO – 2002

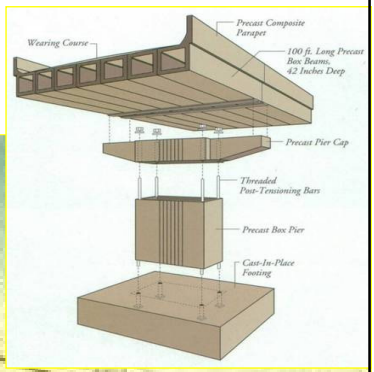
111-ft long, 25-ft high, 425-ton truss span installed over a weekend

Newark International Airport Monorail

I-287 Cross Westchester Viaduct, New York

SH 66 over MITCHELL GULCH, COLORAD - 2002

Baldorioty de Castro Avenue San Juan, Puerto Rico – 1992



Two 700-ft and two 900-ft bridges, each installed in 21-36 hrs

Church Street Bridge, Connecticut

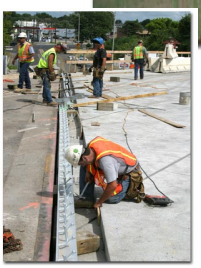
- 320- Feet Truss Span
- 50-feet High and 60-feet Wide
- Total Weight = 850 T
- Lifted and placed in one night
- Minimized Rail Disruptions

Hyper Build Project
Bridges on Route 1, New Jersey

- August 17, '05
  - o2 PM, Sections Arrive at Airport
- August 27, '05
  - o4:10 – 9:30 AM – Removing Old Deck

Hyper Build Project
Bridges on Route 1, New Jersey

- August 28, '05
  - o1:40 AM, Setting Beams in Place
  - o11:55 AM , Installing New Deck
- Compressed Schedule From 24 Months to 3 Weekends
- Cost Savings - $2.5M



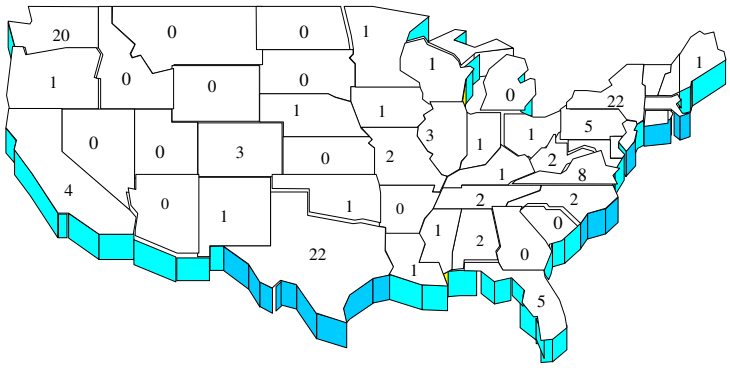
I-45 Pierce Elevated, Texas

- Prefabricated Caps on 226 Spans – 190 Days vs. 1 ½ Years

SH 36 Over Lake Belton, Texas

- Repetitive construction over water
- Precast Columns
- Precast Caps

ABC Scoreboard



Prefabricated Bridge Benefits

- ✓ Minimizes traffic disruptions
- ✓ Improves work-zone safety
- ✓ Minimizes environmental impact
- ✓ Improves constructability
- ✓ Improves product quality
- ✓ Lower costs

PREFABRICATED BRIDGE BENEFITS

- ☑ **Faster**
- ☑ **Safer**
- ☑ **Better Quality**

and …

- ☑ **Lower Cost!**

Moving more cast-in-place construction to offsite location

Prefabrication – Improved Quality & Lower Life-Cycle Costs – to "Stay Out"

- Controlled environment
  - Reduced dependence on weather
  - Established materials suppliers for consistent quality of materials
  - Standardized plant operations for consistent quality of production
  - Optimum concrete curing

Prefabricated Bridges to Accelerate Construction
Survey to Sample State Bridge Engineers

Question: Barriers to routinely install PBES in hours or days?

Summary: Barriers

- Lack of education / training / experience (13)
- Lack of standards & specifications (13)
- Concerns about durability or details (12)
- Higher cost & limited resources (9)
- Lack of perceived need for speed (8)
- Construction industry not geared up for prefab (7)

Prefabricated Bridges to Accelerate Construction
Survey to Sample State Bridge Engineers

Question: What would help most to use PBES?

Summary: Needs

- Education / training / more projects (7)
- Design & construction standards & specifications (6)
- Additional research/development to address concerns about durability or details (5)
- Competitive cost & additional funding (6)
- Appropriate projects that require speed (4)
- Fabrication & construction equipment & methods (5)

Current Activities to Address the Needs

- Education / Training
  - Meetings, workshops, conferences
  - Decision-Making Framework
  - Manual on Use of SPMTs to Move Bridges (on website)
  - Manual on PBES Connection Details (June/July 2009)

  Projects / Details, Standards, and Specifications
  - Online resources on prefabricated bridges

    http://www. fhwa.dot.gov/bridge/prefab
    - Projects – details, contacts, standards, specifications
    - Research
    - Publications

  Technical Advancements, e.g., on durability issues
  - NCHRP and other research projects on connections and other details
  - Available innovative construction equipment

Framework for Prefabricated Bridge Elements and Systems (PBES)
Decision-Making Framework

FHWA Team

Benjamin Tang (Retired)

Vasant Mistry — Helene Bowman

Gary Jakovich (EFLD) — Claude Napier

Eric Gabler — Raj Ailaney

Byron Lord

Framework for PBES Decision-Making

Users

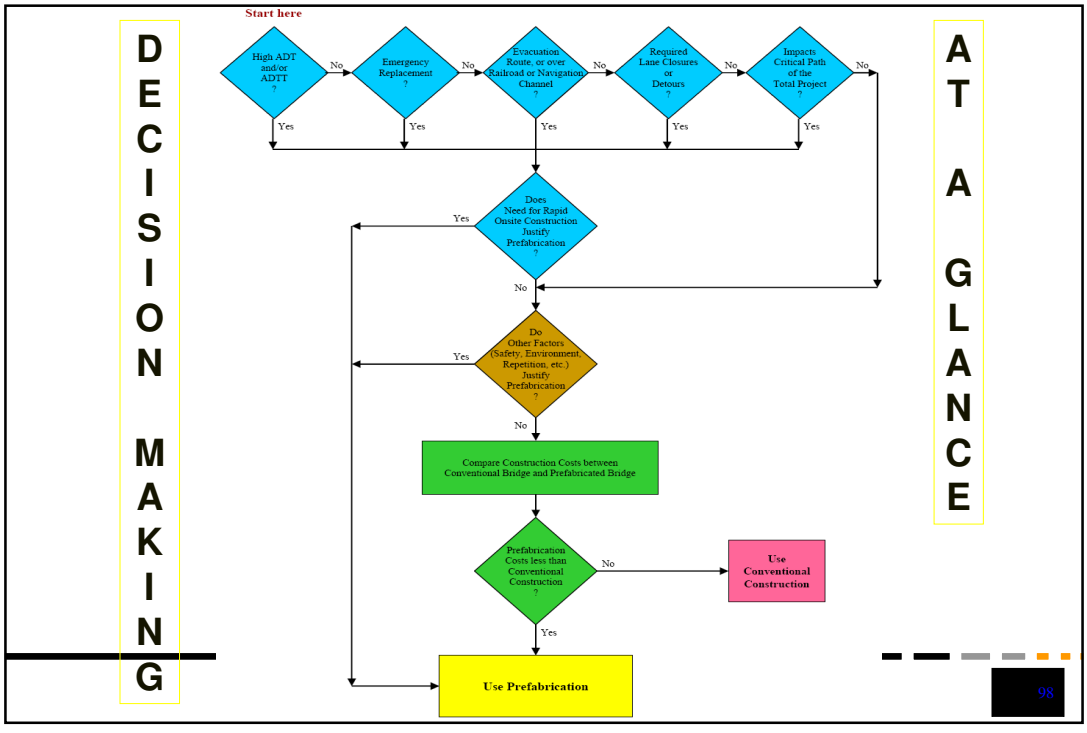
- ✓ Decision makers for bridge type
- ✓ Implementers
  - ✓ Designers
  - ✓ Project Managers

Framework for PBES Decision-Making – In General

- ✓ PBES are faster
- ✓ PBES are safer
- ✓ PBES have lower initial costs
  - ✓ Due to significantly reduced traffic control, risks, environmental impacts, user delay costs
- ✓ PBES are better
  - ✓ Due to improved quality control off-site and off-the-critical-path fabrication

Framework for PBES Decision-Making – Specific Project Considerations

- ✓ Faster
- ✓ Better
- ✓ Safer
- ? Is prefabrication the best solution for this specific project ?
  - ? Lower initial costs ?
  - ? Long lasting ?



Decision-Making Matrix

Example Questions

Question	Yes	Maybe	No
High traffic volume?			
Emergency replacement? . . .			
Worker safety concerns? . . .			
High daily traffic control costs? . . .			

Future Direction

- Widespread use of Accelerated Construction
- Engineering the solution to satisfy unique constraints
  - Traffic disruptions, work zone safety, environmental impact, constructability, improve quality, lower life cycle costs
- Catalogue of Connection Details
- Develop Manual on Prefabricated Systems
- Self Propelled Modular Transport (SPMT) – How To Manual?
- More owner / industry / consultant / academia / public partnerships for optimum solutions

You've heard it said …

"IF YOU WANT IT FAST
IT WON'T BE GOOD
IT WON'T BE CHEAP
IF YOU WANT IT GOOD
IT WON'T BE CHEAP
IT WON'T BE FAST
IF YOU WANT IT CHEAP
IT WON'T BE FAST
IT WON'T BE GOOD

PICK ONE"

Connections Details for Prefabricated Bridge Elements and Systems

Roadblocks to Accelerated Construction

- The primary concerns that owner agencies have with respect to adopting accelerated construction techniques are:
  - Need for Quality Details
  - Durability
  - Design Methodologies and Training
  - Construction Methodologies

"Connections for Prefabricated Bridge Elements and Systems"

- FHWA has initiated a project to develop this manual
- This publication is intended to provide information that will go a long way to answering all four of the previous concerns.
- Focus on details that have been used in the past.

Connection Details for Prefabricated Bridge Elements and Systems

Project Goals

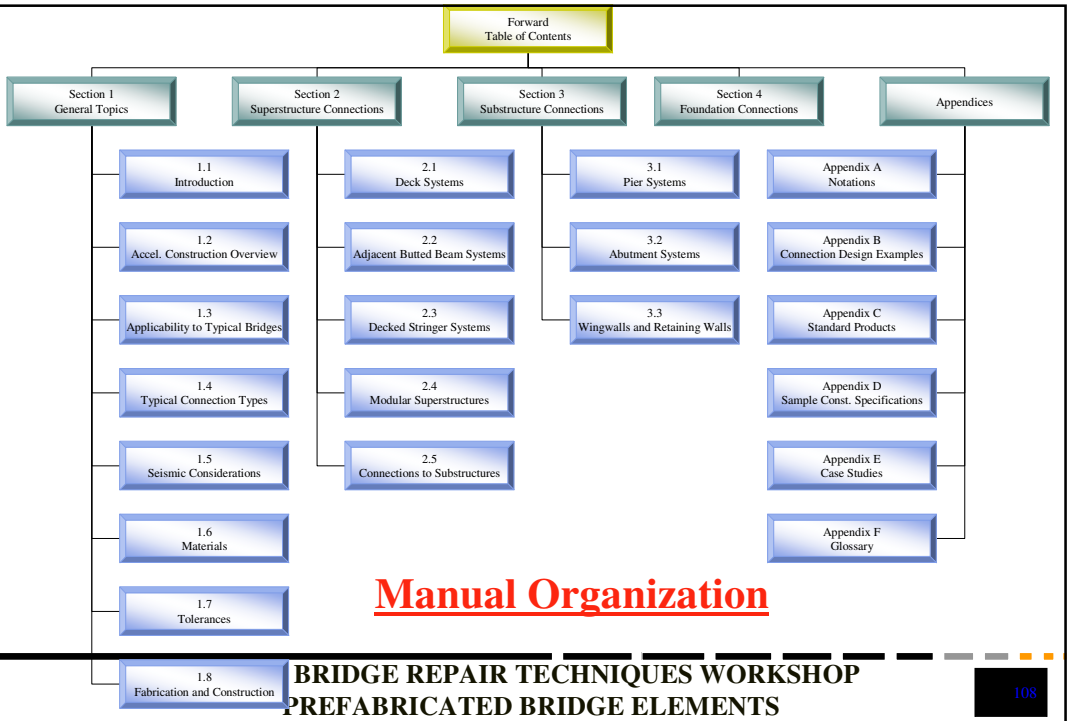
- Gather details of Connections that have been used on accelerated bridge construction projects
- Investigate transfer of technology from other markets into the bridge market
  - o Parking Garages
  - o Stadiums
  - o Buildings

All details needs to pass a critical test before being published in the document:

- o Does the connection result in a rapid construction process?
- o Does the connection transmit the forces between elements effectively?
- o Is the connection durable?
- o Has it performed well under traffic and in an exposed environment?
- o Is it cost effective and easy to construct?
- o If a process or connection is proprietary, can it be incorporated into numerous projects without producing contracting issues?

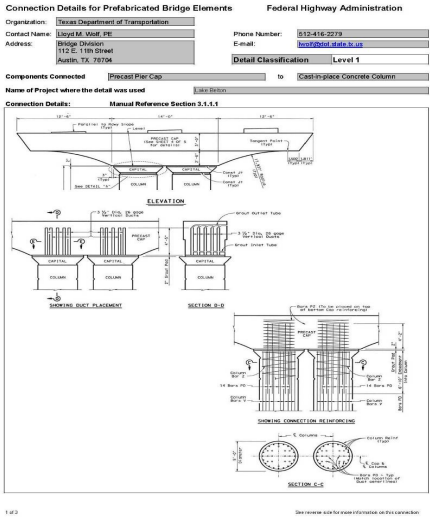
Source of Data

- State DOT's
  - o Questionnaires sent via e-mail
- Federal Agencies
- International Organizations
- Researchers (previous and current)
- Producers
  - o Questionnaires sent via e-mail



Manual Organization

Connection Data Sheets


Connection Details for Prefabricated Bridge Elements — Federal Highway Administration

Organization: Texas Department of Transportation
Contact Name: Lloyd M. Wolf, PE
Address: Bridge Division, 112 E. 11th Street, Austin, TX 78704
Phone Number: 512-416-2279
E-mail: lwolf@dot.state.tx.us
Detail Classification: Level 1

Components Connected: Precast Pier Cap to Cast-in-place Concrete Column
Name of Project where the detail was used: Lake Belton
Connection Details: Manual Reference Section 3.1.1.1

ELEVATION
SHOWING DUCT PLACEMENT
SECTION B-B
SHOWING CONNECTION REINFORCING
SECTION C-C

1 of 3
See reverse side for more information on this connection


Connection Details for Prefabricated Bridge Elements — Federal Highway Administration

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Components Connected: Precast Pier Cap to Cast-in-place Concrete Column
Name of Project where the detail was used: Lake Belton

Description, comments, specifications, and special design procedures

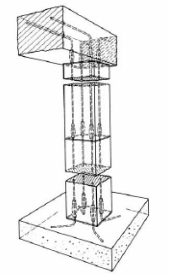
What forces are the connection designed to transmit? (place x in appropriate boxes)
Shear: X Moment: X Compression: X Tension: X Torsion: X
What year was this detail first used?
Condition at last inspection (if known)
How many times has this detail been used?
Year of last inspection
Would you use it again? (yes/no/maybe)
On a scale of 1 to 10, how would you rate the performance of this connection in the following categories?
Speed of Construction: (0 very slow, 10 very fast) When compared to conventional construction
Constructability: (0 difficulty making connection, 10 went together easily)
Cost: (0 expensive, 10 cost effective) When compared to other connection methods
Durability: (0 not durable, 10 very durable)
Inspection Access: (0 not visible, 10 easily inspected)
Future Maintenance: (0 will need maintenance, 10 no maintenance anticipated)

2 of 3
See reverse side for more information on this connection

RAPID BRIDGE REPAIR TECHNIQUES WORKSHOP
PREFABRICATED BRIDGE ELEMENTS
109

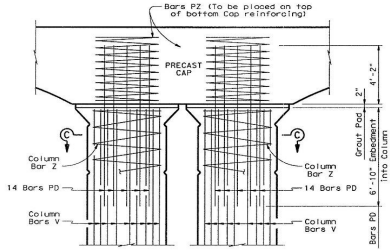
Grouted Splice Connectors

- Emulates a reinforcing steel lap splice
- Three companies – non-proprietary
- Used in precast parking garages and stadiums

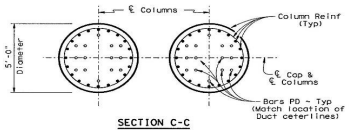


RAPID BRIDGE REPAIR TECHNIQUES WORKSHOP
PREFABRICATED BRIDGE ELEMENTS
110

Precast Piers

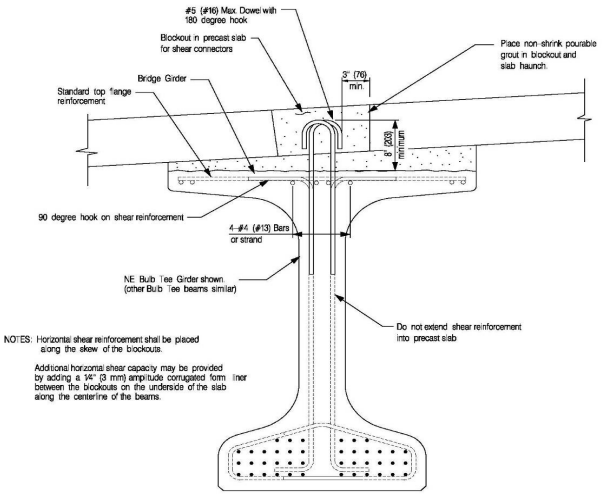


SHOWING CONNECTION REINFORCING



SECTION C-C

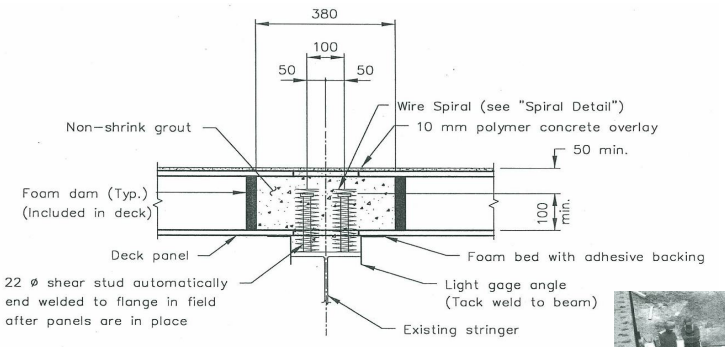
Precast Decks on Concrete Beams



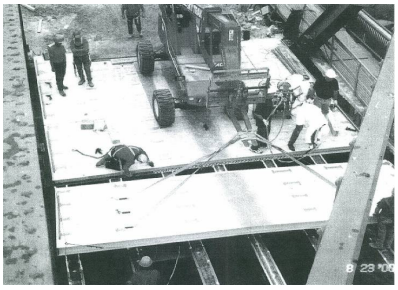
TYPICAL SECTION – BULB TEE BEAMS
NEW CONSTRUCTION

Precast Decks

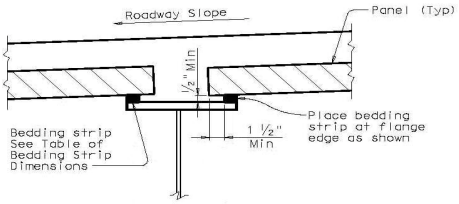
FRP Decks



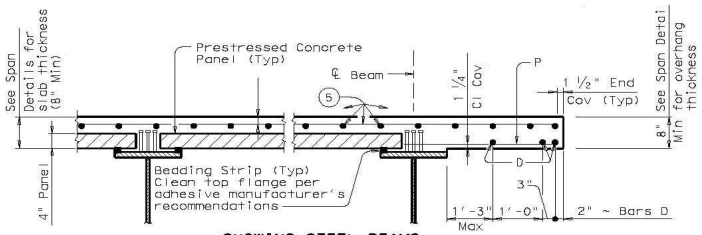
Section A–A



Partial Depth Deck Forms

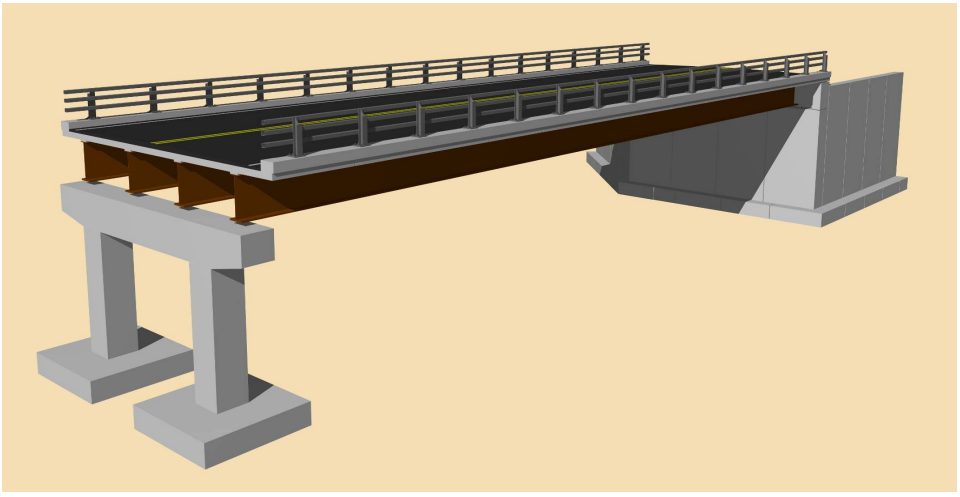


NORMAL GRADING DETAIL (1)

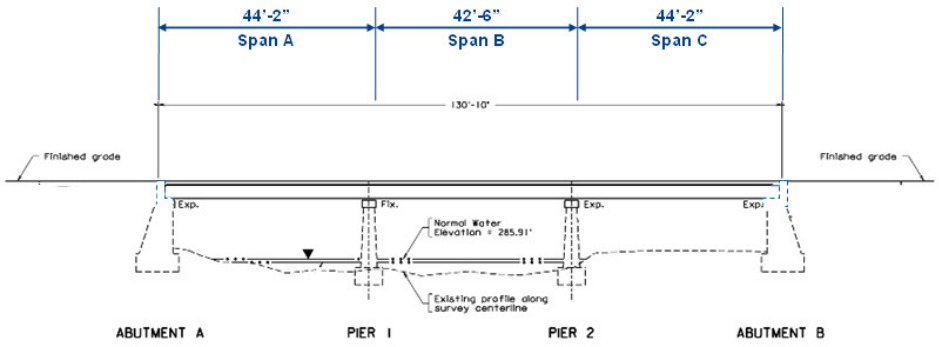


SHOWING STEEL BEAMS

Total Bridge Prefabrication



Rt. 15/29 (SBL) Bridge Superstructure Replacement and Roadway Widening



Existing Bridge Elevation

Prior to Construction

West side view of SBL bridge prior to construction

East side view of SBL bridge prior to construction

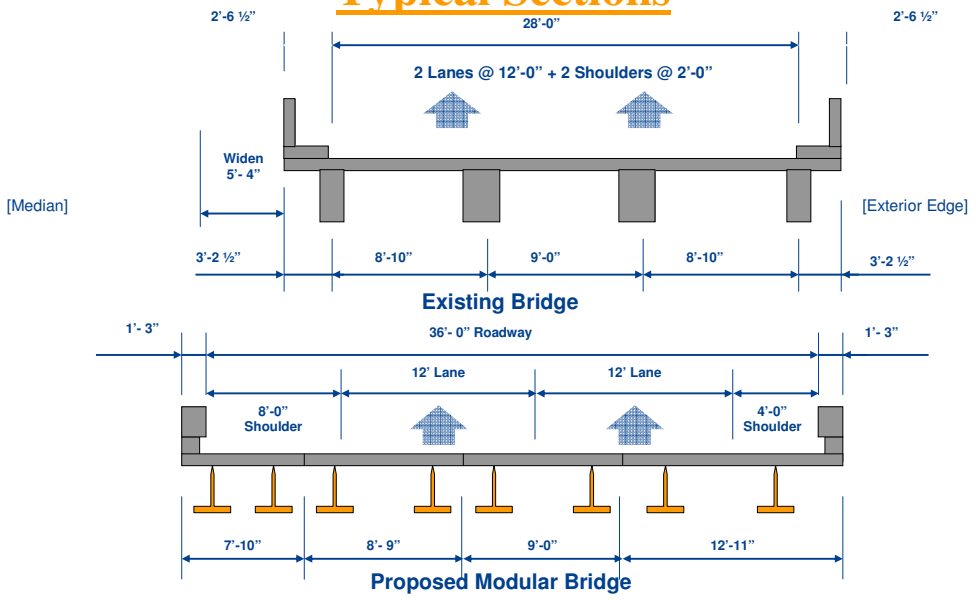
Project Information

- *Location:* The Route 15/29 (SBL) Bridge Superstructure Replacement and Roadway Widening Project over Broad Run is located in Prince William County, 0.55 Mile North of Route 215.
- *Scope:* Work includes replace and widen existing bridge superstructures with offsite-fabricated superstructure segments, substructure concrete widening and repairs, re-alignment and approach work.
- *Superstructure:* 3-Span, Concrete T beam, Simply Supported
- *Substructure:* Wall type piers and abutments
- *Year Built:* 1952
- *ADT:* 25,000
- *Condition:* Structurally deficient and functionally obsolete.

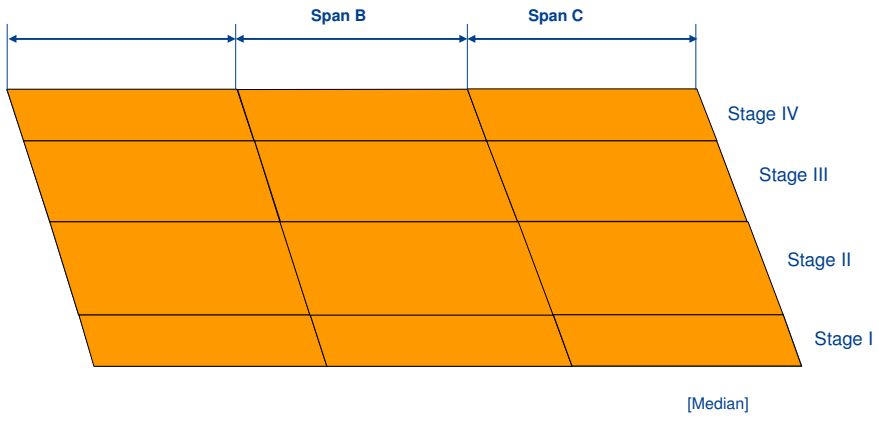
Project Limits

Project limits within the Buckland Historical District and the Mosby Heritage Area

Typical Sections

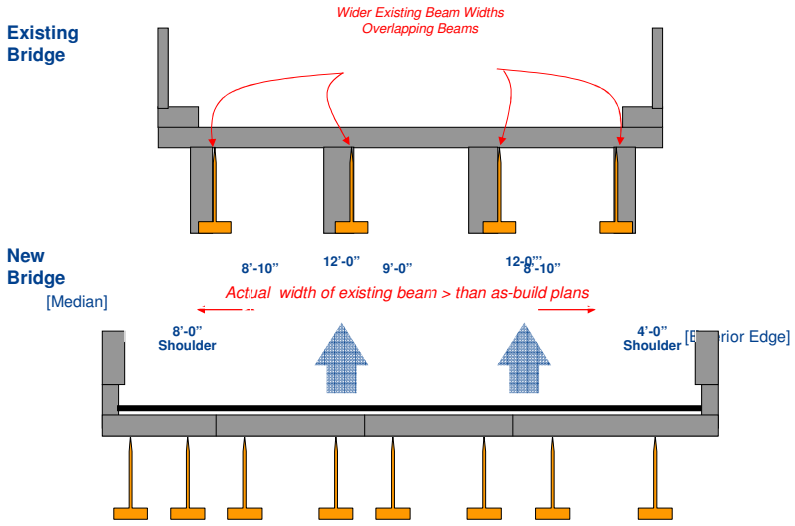


Proposed Sequence of Construction

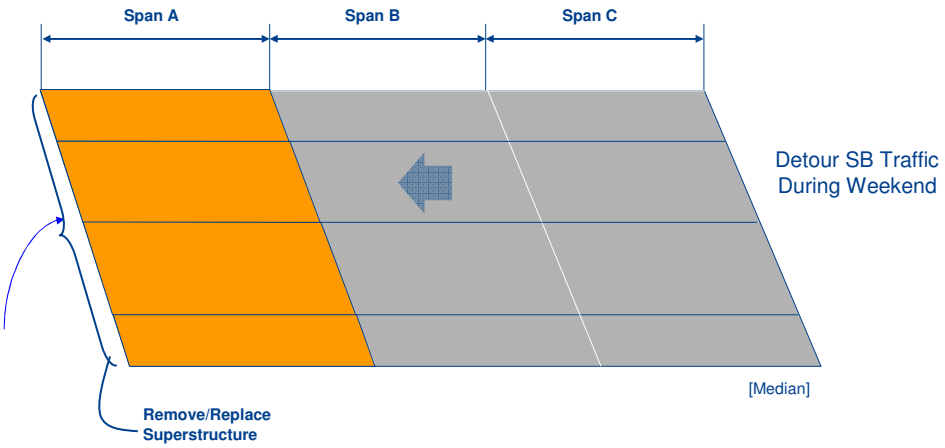


Lessons Learned

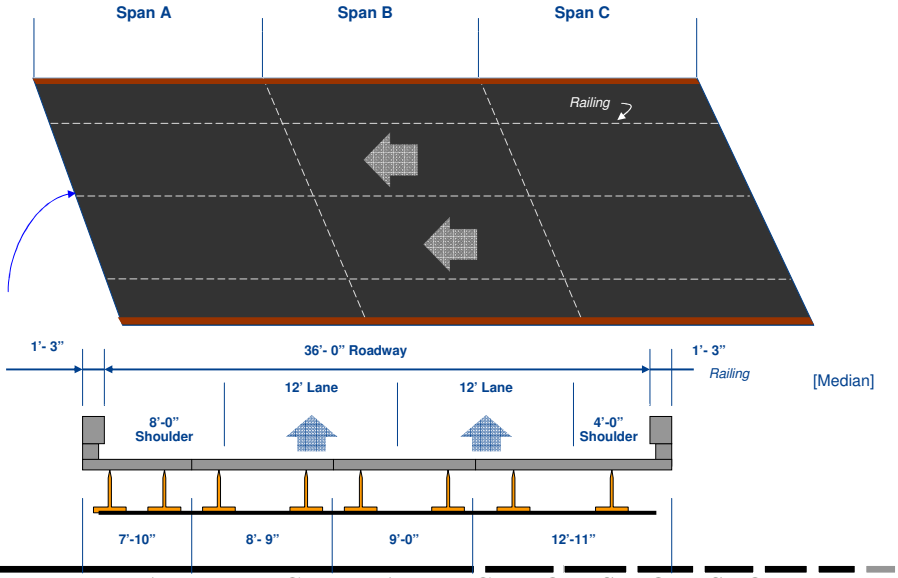
Conflicts With Beams



Revised Construction of Span A



Completed Structure



High Water

Before and after photos of high water after heavy rains (10') in May 2008

High Water

Damages caused by heavy rain after installation of cofferdam (port-a-dam)

Cofferdams

Installation of an additional Cofferdam at Pier 1 needed as a result of high water to complete formwork and concrete pour

Environmental

Demolition Shield

Installation of demolition shield

Weight Limitations

Hand Rails Removed

Removal of existing handrails to reduce weight during the removal of segments

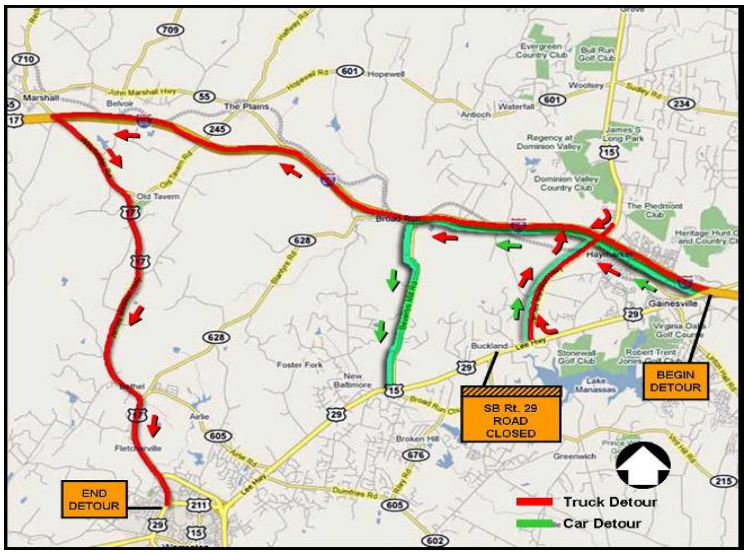
Steel Beams – Galvanization and Shipping

- Steel beams after galvanizing and shipment to Coastal Precast Systems, Inc.

Coastal Prefabricating Modular Deck Units

Revised Construction Sequence

Revised MOT Plan for Weekend Closures



Placing Asphalt at the Abutment and Sealing Deck Joints

Completed Structure with Asphalt Overlay

Project Schedule

- Gather information
  - Fall 2006 through Spring 2007
- Visit states that are leaders in accelerated bridge construction
  - Winter 2007
- Develop manual
  - Summer/Fall 2007
- Complete Manual
  - Summer 2008

Project Delivery

- The document will be available for all owners and designers for use in future accelerated bridge projects
  - Website will be established on the FHWA Highways for Life Website

www.fhwa.dot.gov/hfl/

Available Resources

- **Learn more:**
  - **www. fhwa.dot.gov/bridge/prefab**
- **Tools**:
  - Decision-Making Framework for the Use of Prefabricated Bridges
  - Connection Detail Catalog, How to SPMT manual
  - Specifications for Prefabricated Bridges
- **FHWA Contacts:**

  FHWA Office of Bridge Technology and Resource Center
  - **Vasant Mistry, Raj Ailaney**

AVAILABLE ONLINE RESOURCES

- General Information
  http://www.fhwa.dot.gov/bridge/prefab/
- Projects constructed to date
  http://www.fhwa.dot.gov/bridge/prefab/projects.htm
- Publications
  http://www.fhwa.dot.gov/bridge/prefab/pubs.htm
- Research
  http://www.fhwa.dot.gov/bridge/prefab/research.htm
- Calendar of upcoming events
  http://www.fhwa.dot.gov/bridge/prefab/calendar.htm
- Virginia Division Website
  http://www.fhwa.dot.gov/vadiv/

You can have any two

We suggest speed & quality

However: Elimination of temporary bridges can offset additional cost of rapid construction

ACCELERATED CONSTRUCTION INITIATIVES

- LEAVE YOU WITH THREE (3) THINGS
  - o THINK OUT-OF-THE-BOX.
  - o BE BOLD AND AUDACIOUS.
  - o NEEDS EARLY INVOLVEMENT IN PLANNING AND DESIGN PHASES.

QUESTIONS?

THANK YOU